World Academy of Science, Engineering and Technology
International Journal of Health and Medical Engineering
Vol:16, No:06, 2022

Radiosensitization Properties of Gold Nanoparticles in Brachytherapy of Uterus Cancer by High Dose Rate I-125 Seed: A Simulation Study by MCNPX and MCNP6 Codes

Authors : Elham Mansouri, Asghar Mesbahi

Abstract : Purpose: In the current study, we aimed to investigate the macroscopic and microscopic dose enhancement effect of metallic nanoparticles in interstitial brachytherapy of uterus cancer by Iodin-125 source using a nano-lattice model in MCNPX (5) and MCNP6.1 codes. Materials and methods: Based on a nano-lattice simulation model containing a radiation source and a tumor tissue with cellular compartments loaded with 7mg/g spherical nanoparticles (bismuth, gold, and gadolinium), the energy deposited by the secondary electrons in microscopic and macroscopic level was estimated. Results: The results show that the values of macroscopic DEF is higher than microscopic DEF values and the macroscopic DEF values decreases as a function of distance from the brachytherapy source surface. Also, the results revealed a remarkable discrepancy between the DEF and secondary electron spectra calculated by MCNPX (5) and MCNP6.1 codes, which could be justified by the difference in energy cut-off and electron transport algorithms of two codes. Conclusion: According to the both MCNPX (5) and MCNP6.1 outputs, it could be concluded that the presence of metallic nanoparticles in the tumor tissue of uteruscancer increases the physical effectiveness of brachytherapy by I-125 source. The results presented herein give a physical view of radiosensitization potential of different metallic nanoparticles and could be considered in design of analytical and experimental radiosensitization studies in tumor regions using various radiotherapy modalities in the presence of heavy nanomaterials.

Keywords : MCNPX, MCNP6, nanoparticle, brachytherapy
Conference Title : ICMP 2022 : International Conference on Medical Physics
Conference Location : Barcelona, Spain
Conference Dates : June 09-10, 2022